resistive heating embodiments is preferably constructed from a material that has good thermal conductivity such as aluminum or copper, so as to server as a Faraday shield. A resistive heater wire (such as Nichrome wire) is attached to the Faraday shield bottom layer without being electrically connected thereto and is wound along the radial segments and connective circular loop in a manner which maximizes the electromagnetic resistance (i.e., impedance) of the overall heater wire circuit to the electromagnetic fields produced by the coil. A layer of thermal insulating material is placed on the surfaces of the heater elements. This insulating material improves the efficiency of the heater by minimizing heat losses to the ambient air. This insulation is particularly helpful for the embodiments that utilize forced air convection in order to remove excess heat from the surface of the dielectric lid.

A2 cont

Amend paragraphs nos. 37-39 to read as follows:

A3

37. According to some embodiments, the present invention is embodied as a heating element, a Faraday shield, and a processing chamber in combination with one another. The heating element may be embodied using either fluid (as a conduit for a thermal working fluid to flow through) or electricity (as an electrical heating element).

38. According to other embodiments, the present invention is embodied as a temperature management apparatus for promoting thermal uniformity for a chamber wall using electricity. The apparatus includes a supporting layer and a resistive heating element. The supporting layer has a predetermined shape and has edges. The resistive heating element is disposed on the supporting layer adjacent to the edges of the supporting layer. The supporting layer is adapted to provide thermal communication between the resistive heating element and the chamber wall.

A3 cont

39. The predetermined shape is selected so as to promote even distribution of heat energy over the chamber wall. Preferably the predetermined shape has substantial radial symmetry. According to one embodiment, the supporting layer is shaped to have plural radial elements and a circular element, disposed at the periphery of the supporting layer, that joins the plural radial elements together. According to another embodiment, the supporting layer is shaped to have plural radial elements and a circular element, disposed near the center of the supporting layer, that joins the plural radial elements together. According to either of these embodiments, the circular elements employed are interrupted by at least one gap formed therein. Preferably the supporting layer is electrically conductive so that it forms a Faraday shield.

Amend paragraphs nos. 44-46 to read as follows:

A4

44. Such an apparatus according to the present invention for processing semiconductor wafers also may include an RF coil and a Faraday shield. The RF coil is disposed adjacent to the vacuum chamber so as to couple RF energy into the vacuum chamber. The heater is disposed between the RF coil and the chamber wall. The Faraday shield is disposed between the heater and the chamber wall. Preferably, the heater is substantially electrically transparent to the RF energy coupled into the chamber.

45. Rather than a fixed-shape Faraday shield, such an apparatus according to the present invention for processing a semiconductor wafer is optionally embodied with a Faraday shield having variable shielding efficiency. The variable efficiency Faraday shield is disposed between the heater and the dielectric wall.

46. A Faraday shield is generally understood in the art to be a layer or plate of conductive material disposed between the RF antenna and the lid of the chamber, that is either connected to ground or is electrically floating. Some persons working in this art may refer to such a shielding structure as being a "voltage distribution electrode." As meant in this application, a Faraday

shield is considered to be a general concept that encompasses within its scope a voltage distribution electrode, as well as other conductive electrodes regardless of how they relate to the system electrically.

A4 cont

Amend paragraph no. 54 to read as follows:

A5

54. A resistive heating element **200** follows a path on the circularly-shaped dielectric lid that provides for an even heating of the lid. The resistive heating element **200** rests atop supporting layer **205** that is shown in phantom. The arrowheads along the resistive heating element **200** illustrate flow of electricity. Preferably, the wiring pattern is embodied so as to have a continuous path that provides for current flow in both directions (i.e., both forward and back) along each of the radial segments and the connecting arcuate portions. The reason for the consistent juxtaposition of conductors with current flowing in opposite directions is so that their electromagnetic fields will cancel one another out.

Amend paragraph no. 56 to read as follows:

A6

56. The partial cut-away portion of the view (in the lower right quadrant) shows the top layer of foam insulation **307** stripped away to expose the heater wire **309** resting on the

supporting layer layer **305**. The heater wire **309** is laid out along the piecewise segments **302**, **304** and the circular loop portion **306** in an analogous fashion to the wiring pattern shown fully in Fig. 2.

A6 cont

Amend paragraph no. 59 to read as follows:

59. The partial cut-away portion of the view (in the upper right quadrant) shows the top layer of foam insulation **407** stripped away to expose the heater wire **409** resting on the bottom, supporting layer **405**. The heater wire **409** is laid out along the circular loop portion and **406** the radially aligned piecewise segments **402** in an analogous fashion to the wiring pattern shown fully in Fig. 2.

A7

Amend paragraph no. 61 to read as follows:

61. The partial cut-away portion of the view (on the right side) shows the top layer of foam insulation **527** stripped away to expose the heater wire **529** resting on the bottom, supporting layer **525**. The heater wire **529** is laid out along the piecewise segments **522**, **524** and the semi-circular portion **526** in an analogous fashion to the wiring pattern shown fully in Fig. 2.

A8

Amend paragraphs nos. 66 and 67 to read as follows:

66. Fig. 6 also illustrates (in phantom) an aspect of the present invention that is optional for incorporation into any of the embodiments. The Faraday shields (i.e., heater assembly supporting layers) according the various embodiments are optionally connectable to ground through a variable impedance **620**. The shielding properties of the Faraday shield can be manipulated by varying the value of the variable impedance **620**.

A9

67. Referring to **Fig. 7**, a cross-sectional detail view of an electrical heating assembly, according to various embodiments of the present invention, disposed on a dielectric lid of a vacuum chamber is illustrated. The bottom, supporting layer **710** of the heating assembly according to the resistive heating embodiments is preferably constructed as a Faraday shield from anodized aluminum, but can be suitably constructed from any material that has good thermal conductivity (e.g., aluminum or copper). The Faraday shield **710** is placed in direct contact with the dielectric lid **720** so as to provide good thermal communication therewith. The resistive heater wire segments **730, 731** (formed from material such as Nichrome wire) are attached to the Faraday shield **710** without being electrically connected thereto and are wound along the radial segments and connective circular loop

(refer to Figs. 2 to 5) in a manner which maximizes the electromagnetic resistance (i.e., impedance) of the overall heater wire circuit to the electromagnetic fields produced by the coil. The heater supply current flows in opposite directions in the adjacent wire segments **730**, **731**. That is to say, the current flows into the page for one segment **730** and out of page for its adjacent segment **731**, for example.

A9 cut

Amend paragraphs nos. 69-71 to read as follows:

69. A layer of thermal insulating material **740** (preferably foamed polymer) is placed on the surfaces of the heater wire **730** and may extend over the Faraday shield **710**. This insulating material layer **740** improves the efficiency of the heating assembly by minimizing heat losses to the ambient air. This insulation is particularly helpful for the embodiments that utilize forced air convection in order to remove excess heat from the outer (i.e., top) surface of the dielectric lid **720**.

A10

70. The electrical heating assembly is optionally secured to the lid **720** by a mechanical clamp **750** (shown in phantom) or is secured by an adhesive bond between the lid **720** and the Faraday shield **710** by a heat conductive epoxy. If the RF coil is sufficiently heavy, then the weight of the RF coil alone, resting

on the electrical heating assembly, can be used to secure the electrical heating assembly to the top of the lid **720**.

71. Also shown in phantom is an optional variable impedance **760** connectable between the Faraday shield **710** and ground potential. The shielding properties of the Faraday shield **710** can be manipulated by varying the value of the variable impedance **760**.

Amend paragraph no. 78 to read as follows:

78. In this alternate embodiment, a heating assembly (a heating element **1130** in combination with a Faraday shield **1140** formed as a conductive supporting layer) is placed between the RF coil **1120** and the atmospheric side of the dielectric lid **1112**. The RF coil **1120** couples energy into the vacuum chamber **1110** to thereby excite the process gases inside the chamber into a plasma state. The heating assembly according to this embodiment includes a Faraday shield **1140** that is disposed between the lid **1112** and the electrical heating element portion **1130** of the heating assembly. The Faraday shield **1140** has one or more fluid conduits formed therein to convey thermal working fluid to and from a temperature regulated fluid reservoir. The Faraday shield **1140** is either permitted to float, or is optionally connected to

A11 cont.

ground via a variable impedance.

Amend paragraphs nos. 82-89 to read as follows:

A12

82. Referring to **Fig. 12**, a cross-sectional detail view of an electrical heating assembly, according to the embodiment of Fig. 11 is illustrated. The Faraday shield **1210** is placed in direct contact with the dielectric lid **1120** so as to provide good thermal communication therewith. The resistive heater wire segments **1230, 1231** are attached to the Faraday shield **1210** without being electrically connected thereto and are wound along the radial segments and connective circular loop (refer to Figs. 2 to 5) in a manner which maximizes the electromagnetic resistance (i.e., impedance) of the overall heater wire circuit to the electromagnetic fields produced by the coil. The heater supply current flows in opposite directions in the adjacent wire segments **1230, 1231**.

83. The heating assembly incorporates a pair of fluid channels **1262, 1264** in tandem with one another within the structure of the radial segments and the connecting arcuate segments of the Faraday shield **1210**. A thermal working fluid **1266**, provided from a temperature controlled fluid reservoir, is forced in a first direction through one fluid channel **1262** and in

an opposite direction through the adjacent channel **1264**. The working fluid **1266** provides for heat to be exchanged between the reservoir and the dielectric lid **1220**.

84. A layer of thermal insulating material **1240** is placed on the surfaces of the heater wire segments **1230, 1231** and may extend over the Faraday shield **1210**. This insulating material layer **1240** improves the efficiency of the heating assembly by minimizing heat losses to the ambient air. This insulation is particularly helpful for the embodiments that utilize forced air convection in order to remove excess heat from the outer (i.e., top) surface of the dielectric lid **1220**.

A12 cont

85. The electrical heating assembly is optionally secured to the lid **1220** by a mechanical clamp **1250** (shown in phantom) or is secured by an adhesive bond between the lid **1220** and the Faraday shield **1210** by a heat conductive epoxy.

86. The embodiment illustrated by Figs. 11 and 12 has plural operational modes. In a first operational mode, the working fluid is heated in the fluid reservoir to a temperature above ambient and functions to smooth out thermal transients. Thermal transients arise due to the sudden step changes caused when the electrical heating element is energized and de-energized or when

the fan **1150** is turned on and off (if the fan is incorporated). The constant flow of heated fluid in the channels **1262, 1264** of the Faraday shield **1210** serves as a stabilizing influence.

87. According to a second operational mode, the working fluid is cooled in the fluid reservoir so that it may serve as a mechanism for removing heat from the lid **1220**. In this operational mode the Faraday shield **1210** itself serves as a cooling device in place of the fan **1150**.

A12 cont

88. Of course, in the case of either of these operating modes, the Faraday shield **1210** continues to function to distribute electric potential evenly across the lid **1220** and, when grounded, to act as a shield.

89. Another feature of the invention is that it maintains a more uniform electromagnetic potential across the dielectric lid. The bottom, supporting layer of the heating assembly (alternatively, the conductive conduit in the fluid embodiments) forms a Faraday shield that develops an electromagnetic potential that is approximately equal to the spatially average potential determined over the entire area defined by the heating assembly. Thus, although the active heating structure (either the resistive heating wire or the thermal working fluid) portion of

the heating assembly is transparent to the electromagnetic fields produced by the coil that penetrate the dielectric lid and generate the plasma, the conductive portion of the heating assembly takes on the role of shaping the electric potential produced by the coil. The result of this averaging is the minimization of detrimental effects of electromagnetic potentials that are too high (e.g., sputtering of the dielectric by the plasma) and of electromagnetic potentials that are too low (e.g., heavy by-product depositions on the dielectric lid). The simultaneous control of both the temperature of the dielectric lid and the electrostatic potential in the region directly adjacent to the lid produces conditions that are very favorable for achieving the desired plasma process results on the workpiece.

A12 Cont

IN THE CLAIMS:

Cancel claims 19 and 29-32.

Amend claims 1, 4-6, 14, 17, 28, 33, and 37 so that claims 1-18, 20-28, and 33-38 read as follows:

A13

1. *(Once Amended)* In combination, a heating element, a Faraday shield, and a semiconductor processing chamber, the semiconductor processing chamber comprising:

a wafer support disposed inside the chamber,